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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/675,095	09/28/2000	Giulio Sandini	IMEC186.001AUS	9116

20995 7590 04/07/2005

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EXAMINER	
VILLECCO, JOHN M	
ART UNIT	**PAPER NUMBER**
2612	

DATE MAILED: 04/07/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No. 09/675,095	Applicant(s) SANDINI ET AL.	
	Examiner John M. Villecco	Art Unit 2612	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 25 October 2004.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-13,15 and 17-23 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) 20-23 is/are allowed.

6)☒ Claim(s) 1-13,15 and 17-19 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 28 September 2000 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed October 25, 2004 have been fully considered but they are not persuasive.

2. Regarding claims 1 and 11, applicant argues that the combination of Kreider and Pardo would result in an entirely spatially variant array, as taught by Pardo, and that the feature of a continuous change in density between two different special sensor array configurations is neither shown nor suggest by the aforementioned references. However, Kreider shows that it is well known in the art that a constant resolution foveal area surrounded by radially changing resolution area, accurately replicates the vision of the human eye (col. 2, lines 14-19). Kreider teaches the use of a typical square CCD for use in the foveal area. As shown in Figures 1 and 2, this configuration leaves dead areas about the CCD and concentric rings. Pardo was used merely to show that the use of concentric rings in a foveal area is well known in the art. Although Pardo does not disclose a constant resolution foveal area, this fact is irrelevant because Kreider teaches a constant resolution foveal area. The use of a constant resolution foveal area consisting of concentric rings would eliminate the dead areas surrounding the CCD in the Kreider reference. Therefore, one of ordinary skill in the art at the time the invention was made would have found it obvious to modify the Kreider reference by including a constant resolution foveal area consisting of concentric rings.

3. For the reasons stated above the rejection of claims 1-5 and 11-18 from the previous office action will be repeated.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. **Claims 1-4, 6-9, 21/1, 22/21/1, and 23/21/1 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kreider et al. (U.S. Patent No. 5,166,511) in view of Pardo et al. ("Space-Variant Nonorthogonal Structure CMOS Image Sensor Design", IEEE Journal of Solid-State Circuits, June 1998).**

6. Regarding *claim 1*, Kreider discloses an image sensor which consists of a square CCD (7) disposed in the middle of the image sensor and a series of rings including radiation sensitive elements surrounding the image sensor (7). The CCD (7) inherently has a constant resolution. The rings have a radial change of the density or resolution of the radiation sensitive elements, thereby approximating the construction of the human eye. See column 2, lines 5-26.

Kreider, however, fails to disclose that the center, or fovea, of the image sensor is comprised of circular arrays of pixels. Pardo, on the other hand, discloses a foveated image sensor which includes a fovea area and a retinal area. The foveal area has 20 rings with a decreasing number of pixels towards the center. Each ring is comprised of a one-dimensional array of equally spaced sensor sites. The retinal area is concentric to the foveal area. Furthermore, as one moves further out on the radius of the image sensor the resolution between the fovea and retina decreases. Additionally, Pardo discloses that the density of sensor elements

continuously decreases as you move to the outer periphery of the image sensory. Thus, the density of sensor element location sites is continuously changing between the constant resolution portion and the spatially variant portion. As disclosed in Kreider, the purpose of his invention was to replicate the human eye using an image sensor. The arrangement of Pardo clearly improves on Kreider's invention by eliminating the dead areas around the rectangular CCD. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use concentric rings in the foveal area also, so that the human eye is more precisely replicated.

7. With regard to ***claim 2***, Pardo discloses that the foveal area consists of 20 rings with an increasing number of pixels per ring as one moves radially outward. For instance, the first ring has four pixels, the second ring has eight pixels, the next two rings have 16 pixels, the next five rings have 32 pixels, and the last ten rings have 64 pixels. Therefore, the step increases per ring of pixels always follows the equation n+m, where n is never equal to 1.

8. As for ***claim 3***, Pardo discloses structures similar to applicant's structures as disclosed in Figure 17, which has an aspect within the range of 2.1 to 0.6. Since they have similar structures the aspect ratios would be the same. Additionally, it is well known in the art that most display arrangements have aspect ratios within the range of 2.1 to 0.6. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have aspect ratios of 2.1 to 0.6 so that it may be displayed appropriately on a display.

9. As for ***claim 4***, the rings are circles.

10. Regarding ***claim 6***, Pardo discloses that the image sensor is arranged with a log polar sensor element location site density. See section II.

11. As for ***claim 7***, Pardo discloses that the retinal area consists of 56 rings each having 128 pixels per ring. See paragraph 6 of page 843.

12. With regard to ***claim 8***, clearly one of ordinary skill in the art would have found a way to smoothly merge the constant resolution portion into the spatially variant portion of the array. By doing this, an image can be formed that is free of distortion from a choppy merger of the two array areas.

13. Regarding ***claim 9***, Pardo discloses concentric rings with a similar number of pixels per ring. One of ordinary skill in the art would have found it obvious to begin the spatially variant array with the same number of pixels per ring as the last ring of the constant resolution sensor so that a seamless transition between the two different arrays can be formed.

14. As for ***claim 21/1***, both Pardo and Kreider disclose that each sensor element comprises electronics technology. This phrase is extremely broad. Therefore, the wiring of either Kreider or Pardo is interpreted to be the electronics technology.

15. With regard to ***claim 22/21/1***, Pardo discloses that the sensor elements are CMOS pixels.

16. Regarding ***claim 23/21/1***, Pardo discloses that the sensor elements are CMOS pixels.

17. <u>Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kreider et al. (U.S. Patent No. 5,166,511) in view of Pardo et al. ("Space-Variant Nonorthogonal Structure CMOS Image Sensor Design", IEEE Journal of Solid-State Circuits, June 1998, hereinafter referred to as Pardo 1998) and further in view of Pardo et al. ("CMOS Foveated Image Sensor: Signal Scaling and Small Geometry Effects", IEEE Transactions on Electron Devices, October 1997, hereinafter referred to as Pardo 1997).</u>

18. Regarding ***claim 5***, as mentioned above both Kreider and Pardo 1998 disclose all of the limitations of the parent claim. However, none of the aforementioned references discloses that the integer m is between 3 and 10. While Pardo 1998 does teach that the number of pixels per ring decreases as you approach the center and that the maximum number of pixels in the foveal area is 64, Pardo 1998 discloses that this reduction in pixels is graded based on the ring number. However, Pardo 1997 discloses that the number of pixels per ring is decreased as one approaches the center of the image sensor. Therefore, the reduction of pixels per ring is not graded. Furthermore, as taught by Pardo 1998 the maximum number of pixels per ring is 64. In order to decrease the number of pixels from 64 to 1 in 20 rings, one could reduce the number of pixels per ring by 3. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to reduce the number of pixels per line in a non-graded manner by decreasing the number of pixels per ring by 3 in order to form a seamless transition between the number of rings per pixel.

19. **Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kreider et al. (U.S. Patent No. 5,166,511) in view of Pardo et al. ("Space-Variant Nonorthogonal Structure CMOS Image Sensor Design", IEEE Journal of Solid-State Circuits, June 1998, hereinafter referred to as Pardo 1998) and further in view of Watanabe (U.S. Patent No. 6,522,356)**.

20. Regarding ***claim 10***, as mentioned above both Kreider and Pardo disclose all of the limitations of the parent claims. However, neither of the aforementioned references specifically discloses that in the spatially variant area the $i+1^{th}$ ring of pixels is shifted by half the distance of

the i^{th} ring of pixels. Watananbe, on the other hand, discloses that it is well known in the art to shift pixels in an image sensor by half the distance of the preceding row of pixels. More specifically, as shown in Figure 1a-1c and 3a, the each successive row is shifted by half the distance between pixels of the previous row. This arrangement allows for an array that can generate high-resolution color signals. See column 15, lines 22-28 and column 4, lines 40-42. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to shift the pixels of Kreider and Pardo by half the distance of the pixel in a previous row so that the array is arranged such that high resolution can be obtained in the horizontal, vertical and oblique directions and well-balanced color resolution is attained. See column 4, lines 44-45.

21. <u>Claims 11, 12, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pardo et al. ("Space-Variant Nonorthogonal Structure CMOS Image Sensor Design", IEEE Journal of Solid-State Circuits, June 1998) in view of Kreider et al. (U.S. Patent No. 5,166,511).</u>

22. Regarding ***claim 11***, Pardo, discloses a foveated image sensor which includes a fovea area and a retinal area. The foveal area has 20 rings with a decreasing number of pixels towards the center. Each ring is comprised of a one-dimensional array of equally spaced sensor sites. Pardo discloses that the foveal area consists of 20 rings with an increasing number of pixels per ring as one moves radially outward. For instance, the first ring has four pixels, the second ring has eight pixels, the next two rings have 16 pixels, the next five rings have 32 pixels, and the last

ten rings have 64 pixels. Therefore, the step increases per ring of pixels always follows the equation n+m, where n is never equal to 1. Additionally, each ring makes a close smooth curve. See the fifth paragraph of page 843. Pardo discloses that the density of sensor elements continuously decreases as you move to the outer periphery of the image sensory. Thus, the density of sensor element location sites is continuously changing between the constant resolution portion and the spatially variant portion.

Pardo, however, fails to specifically disclose that the resolution of the sensor array is constant. Kreider discloses an image sensor which consists of a square CCD (7) disposed in the middle of the image sensor and a series of rings including radiation sensitive elements surrounding the image sensor (7). The CCD (7) inherently has a constant resolution. Clearly in order to approximate the construction of the human eye, the foveal area of the image sensor would strive to have a substantially constant resolution. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to make the foveal area of the Pardo image sensor a constant resolution to approximate the construction of the human eye.

23. As for ***claim 12***, Pardo discloses structures similar to applicant's structures as disclosed in Figure 17, which has an aspect within the range of 2.1 to 0.6. Since they have similar structures the aspect ratios would be the same. Additionally, it is well known in the art that most display arrangements have aspect ratios within the range of 2.1 to 0.6. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have aspect ratios of 2.1 to 0.6 so that it may be displayed appropriately on a display.

24. With regard to ***claim 19***, Pardo, discloses a foveated CMOS image sensor which includes a fovea area and a retinal area. The foveal area has 20 rings with a decreasing number of pixels

towards the center. Each ring is comprised of a one-dimensional array of equally spaced sensor sites. Pardo discloses that the foveal area consists of 20 rings with an increasing number of pixels per ring as one moves radially outward. For instance, the first ring has four pixels, the second ring has eight pixels, the next two rings have 16 pixels, the next five rings have 32 pixels, and the last ten rings have 64 pixels. Therefore, the step increases per ring of pixels always follows the equation n+m, where n is never equal to 1. Additionally, each ring makes a close smooth curve. See the fifth paragraph of page 843. Pardo discloses that the density of sensor elements continuously decreases as you move to the outer periphery of the image sensory. Thus, the density of sensor element location sites is continuously changing between the constant resolution portion and the spatially variant portion.

Pardo, however, fails to specifically disclose that the resolution of the sensor array is constant. Kreider discloses an image sensor which consists of a square CCD (7) disposed in the middle of the image sensor and a series of rings including radiation sensitive elements surrounding the image sensor (7). The CCD (7) inherently has a constant resolution. Clearly in order to approximate the construction of the human eye, the foveal area of the image sensor would strive to have a substantially constant resolution. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to make the foveal area of the Pardo image sensor a constant resolution to approximate the construction of the human eye.

25. **Claims 13, 15, 17, and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pardo et al. ("Space-Variant Nonorthogonal Structure CMOS Image Sensor Design", IEEE Journal of Solid-State Circuits, June 1998, hereinafter referred to as Pardo 1998) in**

view of Kreider et al. (U.S. Patent No. 5,166,511) and further in view of Pardo et al. ("CMOS Foveated Image Sensor: Signal Scaling and Small Geometry Effects", IEEE Transactions on Electron Devices, October 1997, hereinafter referred to as Pardo 1997).

26. As for ***claim 13***, as mentioned above both Kreider and Pardo 1998 disclose all of the limitations of the parent claim. However, none of the aforementioned references discloses that the integer m is between 3 and 10. While Pardo 1998 does teach that the number of pixels per ring decreases as you approach the center and that the maximum number of pixels in the foveal area is 64, Pardo 1998 discloses that this reduction in pixels is graded based on the ring number. However, Pardo 1997 discloses that the number of pixels per ring is decreased as one approaches the center of the image sensor. Therefore, the reduction of pixels per ring is not graded. Furthermore, as taught by Pardo 1998 the maximum number of pixels per ring is 64. In order to decrease the number of pixels from 64 to 1 in 20 rings, one could reduce the number of pixels per ring by 3. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to reduce the number of pixels per line in a non-graded manner by decreasing the number of pixels per ring by 3 in order to form a seamless transition between the number of rings per pixel.

27. Regarding ***claim 15***, both Pardo's disclose that the spatially variant array has a log polar sensor element location site density.

28. As for ***17***, both Pardo's disclose that the retinal area consists of 56 rings each having 128 pixels per ring. See paragraph 6 of page 843.

29. With regard to ***claim 18***, both Pardo's disclose an image sensor which is sensitive to radiation.

Allowable Subject Matter

30. Claims 20-23 are allowed.

31. The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 20, the primary reason for indication of allowable subject matter is that the prior art fails to teach or reasonably suggest that the spatially variant portion is surrounded by the constant resolution portion as shown in Figures 12a and 12b of the applicants specification.

32. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John M. Villecco whose telephone number is (571) 272-7318. The examiner can normally be reached on Monday-Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wendy Garber can be reached on (571) 272-7308. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

John M. Villecco
March 22, 2005

WENDY R. GARBER
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